

WHAT IS CLAIMED IS:

1           1.    A rotation stabilizing device in a  
2 microgravitational rotating apparatus, said  
3 microgravitational rotating apparatus comprising a casing,  
4 a rotary shaft, provided within said casing, having its  
5 both ends supported by bearings so as to be rotationally  
6 driven by a motor and a plurality of arms, extending  
7 radially, having their one ends fitted and supported to  
8 said rotary shaft and the other ends fitted with a  
9 plurality of boxes in which objects having weight are  
10 placed, wherein said rotation stabilizing device  
11 comprises a rotation stabilizing means provided between  
12 said casing and said plurality of boxes or between an outer  
13 side of said casing and a stationary side or between said  
14 rotary shaft and said plurality of arms.

1           2.    A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a flat plate ring shape, fixed to outer  
4 circumferential surfaces of said plurality of boxes so as  
5 to extend orthogonally to said rotary shaft, a pair of  
6 electromagnetic coils, facing each other, fitted to a wall  
7 surface of said casing at each of a plurality of places  
8 of a circumferential periphery of said fin so that said  
9 fin may be interposed between said electromagnetic coils

10 of the pair with a predetermined gap being maintained  
11 between said fin and said respective electromagnetic coils  
12 of the pair, a gap sensor, detecting variations in said  
13 gap, fitted to the wall surface of said casing close to  
14 said electromagnetic coils of the pair and a control unit  
15 taking detected signals of said gap sensor and comparing  
16 said signals with a set value to thereby control exciting  
17 current of said electromagnetic coils of the pair existing  
18 at the position corresponding to said gap sensor that  
19 detected said signals in excess of said set value so that  
20 said gap may fall within said set value.

1 3. A rotation stabilizing device as claimed in  
2 Claim 2, wherein said fin, instead of having the flat plate  
3 shape, has a frusta-conical shape of which conical surface  
4 is inclined with a predetermined angle.

1 4. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a cylindrical shape, fixed to each of upper  
4 and lower surfaces of said plurality of boxes so as to  
5 extend in the same direction as said rotary shaft, a pair  
6 of electromagnetic coils, facing each other, fitted to a  
7 wall surface of said casing at each of a plurality of places  
8 of a circumferential periphery of said fin so that said  
9 fin may be interposed between said electromagnetic coils  
10 of the pair with a predetermined gap being maintained

11 between said fin and said respective electromagnetic coils  
12 of the pair, a gap sensor, detecting variations in said  
13 gap, fitted to the wall surface of said casing close to  
14 said electromagnetic coils of the pair and a control unit  
15 taking detected signals of said gap sensor and comparing  
16 said signals with a set value to thereby control exciting  
17 current of said electromagnetic coils of the pair existing  
18 at the position corresponding to said gap sensor that  
19 detected said signals in excess of said set value so that  
20 said gap may fall within said set value.

1 5. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a flat plate ring shape, fixed to outer  
4 circumferential surfaces of said plurality of boxes so as  
5 to extend orthogonally to said rotary shaft, a pair of  
6 electromagnetic coils, facing each other, arranged at each  
7 of a plurality of places of a circumferential periphery  
8 of said fin so that said fin may be interposed between said  
9 electromagnetic coils of the pair with a predetermined gap  
10 being maintained between said fin and said respective  
11 electromagnetic coils of the pair, a pair of cylinders,  
12 fixed to said casing on one hand and connected to said  
13 electromagnetic coils of the pair on the other hand so that  
14 said electromagnetic coils of the pair may be moved and  
15 said gap relative to said fin may be changed, a gap sensor,

16 detecting variations in said gap, fitted to a wall surface  
17 of said casing close to said electromagnetic coils of the  
18 pair and a control unit taking detected signals of said  
19 gap sensor and comparing said signals with a set value to  
20 thereby control to drive said cylinders of the pair  
21 existing at the position corresponding to said gap sensor  
22 that detected said signals in excess of said set value so  
23 that said electromagnetic coils of the pair connected to  
24 said cylinders may be moved and said gap may fall within  
25 said set value.

1 6. A rotation stabilizing device as claimed in  
2 Claim 5, wherein said fin, instead of having the flat plate  
3 shape, has a frusta-conical shape of which conical surface  
4 is inclined with a predetermined angle.

1 7. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a cylindrical shape, fixed to each of upper  
4 and lower surfaces of said plurality of boxes so as to  
5 extend in the same direction as said rotary shaft, a pair  
6 of electromagnetic coils, facing each other, arranged at  
7 each of a plurality of places of a circumferential  
8 periphery of said fin so that said fin may be interposed  
9 between said electromagnetic coils of the pair with a  
10 predetermined gap being maintained between said fin and  
11 said respective electromagnetic coils of the pair, a pair

12 of cylinders, fixed to said casing on one hand and  
13 connected to said electromagnetic coils of the pair on the  
14 other hand so that said electromagnetic coils of the pair  
15 may be moved and said gap relative to said fin may be changed,  
16 a gap sensor, detecting variations in said gap, fitted to  
17 a wall surface of said casing close to said electromagnetic  
18 coils of the pair and a control unit taking detected  
19 signals of said gap sensor and comparing said signals with  
20 a set value to thereby control to drive said cylinders of  
21 the pair existing at the position corresponding to said  
22 gap sensor that detected said signals in excess of said  
23 set value so that said electromagnetic coils of the pair  
24 connected to said cylinders may be moved and said gap may  
25 fall within said set value.

1 8. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a flat plate ring shape, fixed to an inner  
4 circumferential wall surface of said casing so as to extend  
5 orthogonally to said rotary shaft, a pair of  
6 electromagnetic coils, facing each other, fitted to an  
7 outer circumferential surface of each of said plurality  
8 of boxes so that said fin may be interposed between said  
9 electromagnetic coils of the pair with a predetermined gap  
10 being maintained between said fin and said respective  
11 electromagnetic coils of the pair, a gap sensor, detecting

12 variations in said gap, fitted to the outer  
13 circumferential surface of each of said plurality of boxes  
14 close to said electromagnetic coils of the pair and a  
15 control unit taking detected signals of said gap sensor  
16 and comparing said signals with a set value to thereby  
17 control exciting current of said electromagnetic coils of  
18 the pair existing at the position corresponding to said  
19 gap sensor that detected said signals in excess of said  
20 set value so that said gap may fall within said set value.

1 9. A rotation stabilizing device as claimed in  
2 Claim 8, wherein said fin, instead of having the flat plate  
3 shape, has a frusta-conical shape of which conical surface  
4 is inclined with a predetermined angle.

1 10. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a cylindrical shape, fixed to each of upper  
4 and lower inner wall surfaces of said casing so as to extend  
5 in the same direction as said rotary shaft, a pair of  
6 electromagnetic coils, facing each other, fitted to each  
7 of upper and lower surfaces of said plurality of boxes so  
8 that said fin may be interposed between said  
9 electromagnetic coils of the pair with a predetermined gap  
10 being maintained between said fin and said respective  
11 electromagnetic coils of the pair, a gap sensor, detecting  
12 variations in said gap, fitted to each of the upper and



13 lower surfaces of said plurality of boxes close to said  
14 electromagnetic coils of the pair and a control unit taking  
15 detected signals of said gap sensor and comparing said  
16 signals with a set value to thereby control exciting  
17 current of said electromagnetic coils of the pair existing  
18 at the position corresponding to said gap sensor that  
19 detected said signals in excess of said set value so that  
20 said gap may fall within said set value.

1 11. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a flat plate ring shape, fixed to an inner  
4 circumferential wall surface of said casing so as to extend  
5 orthogonally to said rotary shaft, a pair of cylinders,  
6 facing each other, fitted to each of outer circumferential  
7 surfaces of said plurality of boxes, a pair of  
8 electromagnetic coils, facing each other, connected to  
9 said cylinders of the pair so that said fin may be  
10 interposed between said electromagnetic coils of the pair  
11 with a predetermined gap being maintained between said fin  
12 and said respective electromagnetic coils of the pair as  
13 well as so that said gap may be made adjustable, a gap sensor,  
14 detecting variations in said gap, fitted to each of the  
15 outer circumferential surfaces of said plurality of boxes  
16 close to said electromagnetic coils of the pair and a  
17 control unit taking detected signals of said gap sensor

18 and comparing said signals with a set value to thereby  
19 control said cylinders of the pair existing at the position  
20 corresponding to said gap sensor that detected said  
21 signals in excess of said set value so that said gap may  
22 fall within said set value.

1 12. A rotation stabilizing device as claimed in  
2 Claim 11, wherein said fin, instead of having the flat  
3 plate shape, has a frusta-conical shape of which conical  
4 surface is inclined with a predetermined angle.

1 13. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means comprises  
3 a fin, having a cylindrical shape, fixed to each of upper  
4 and lower surfaces of said casing so as to extend in the  
5 same direction as said rotary shaft, a pair of cylinders,  
6 facing each other, fitted to each of upper and lower  
7 surfaces of said plurality of boxes, a pair of  
8 electromagnetic coils, facing each other, connected to  
9 said cylinders of the pair so that said fin may be  
10 interposed between said electromagnetic coils of the pair  
11 with a predetermined gap being maintained between said fin  
12 and said respective electromagnetic coils of the pair as  
13 well as so that said gap may be made adjustable, a gap sensor,  
14 detecting variations in said gap, fitted to each of the  
15 upper and lower surfaces of said plurality of boxes close  
16 to said electromagnetic coils of the pair and a control



17 unit taking detected signals of said gap sensor and  
18 comparing said signals with a set value to thereby control  
19 said cylinders of the pair existing at the position  
20 corresponding to said gap sensor that detected said  
21 signals in excess of said set value so that said gap may  
22 fall within said set value.

1 14. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means is a  
3 vibration isolating device supporting said casing at each  
4 of a plurality of places of an outer peripheral portion  
5 of said casing and said vibration isolating device  
6 comprises a spring mechanism elastically supporting said  
7 casing to a stationary side member and an  
8 electromagnetically supporting mechanism comprising an  
9 exciting coil connected to said spring mechanism to  
10 electromagnetically support said spring mechanism to said  
11 stationary side member by exciting said exciting coil.

1 15. A rotation stabilizing device as claimed in  
2 Claim 14, wherein said vibration isolating device further  
3 comprises a gap sensor detecting a gap between said casing  
4 and said stationary side member and a control unit taking  
5 detected signals of said gap sensor and, in case of  
6 detection of said gap in excess of a predetermined range,  
7 controlling exciting current of said exciting coil so as  
8 to reduce vibration.

1           16. A rotation stabilizing device as claimed in  
2 Claim 14, wherein said vibration isolating device further  
3 comprises a gap sensor detecting a gap between said casing  
4 and said stationary side member and a control unit taking  
5 detected signals of said gap sensor to detect signal  
6 variations and putting out such drive signals as to cancel  
7 said signal variations so that exciting current of said  
8 exciting coil may be controlled by said drive signals to  
9 thereby control to reduce vibration.

1           17. A rotation stabilizing device as claimed in  
2 any of Claims 14 to 16, wherein said spring mechanism  
3 comprises a casing side frame member fitted to said casing,  
4 a stationary side frame member fitted to said stationary  
5 side member and a spring connecting said casing side frame  
6 member and said stationary side frame member and said  
7 electromagnetically supporting mechanism has said  
8 exciting coil fitted to said casing side frame member and  
9 comprises a conductor fitted to said stationary side frame  
10 member so as to be inserted into said casing side frame  
11 member with a predetermined gap being maintained between  
12 said conductor and said casing side frame member.

1           18. A rotation stabilizing device as claimed in  
2 any of Claims 14 to 17, wherein said spring mechanism uses  
3 one or more bar-like rod springs.

1           19. A rotation stabilizing device as claimed in

2 any of Claims 14 to 17, wherein said spring mechanism uses  
3 one or more bar-like coil springs.

1 20. A rotation stabilizing device as claimed in  
2 any of Claims 14 to 17, wherein said spring mechanism uses  
3 one or more members made of rubber, plastics, etc. having  
4 a predetermined elasticity.

1 21. A rotation stabilizing device as claimed in  
2 Claim 1, wherein said rotation stabilizing means is a  
3 safety device interposed between said rotary shaft and  
4 said plurality of arms and, if said rotary shaft stops  
5 suddenly, said safety device disconnects said rotary shaft  
6 and said plurality of arms from each other so that said  
7 plurality of arms may rotate freely from said rotary shaft.

1 22. A rotation stabilizing device as claimed in  
2 Claim 21, wherein said safety device comprises an actuator  
3 fitted within each of said plurality of arms, a pin fitted  
4 to an end of a rod of said actuator and a sensor detecting  
5 a rotation of said rotary shaft and, when said rod of said  
6 actuator elongates to thereby cause said pin of the rod  
7 end to engage with a pin hole provided in said rotary shaft,  
8 said plurality of arms become rotatable together with said  
9 rotary shaft and, if said rotary shaft stops suddenly, said  
10 rod is retracted, based on a signal from said sensor, to  
11 thereby disengage said pin from said pin hole.

1 23. A rotation stabilizing device as claimed in

Claim 21, wherein said plurality of arms are radially fixed to a connecting shaft, said rotary shaft is separated to an upper rotary shaft and a lower rotary shaft so that said connecting shaft is interposed therebetween, there are provided an actuator fitted within each of said upper and lower rotary shafts, a pin fitted to an end of a rod of said actuator and a sensor detecting a rotation of said rotary shaft and, when said rod of said actuator elongates to thereby cause said pin of the rod end to engage with a pin hole provided in said connecting shaft, said connecting shaft becomes rotatable together with said rotary shaft and, if said rotary shaft stops suddenly, said rod is retracted, based on a signal from said sensor, to thereby disengage said pin from said pin hole.

24. A rotation stabilizing device as claimed in Claim 21, wherein said safety device comprises an actuator, having a rod of which end is formed in a round shape, fitted within each of said plurality of arms, a sensor detecting a rotation of said rotary shaft and an abutting portion, having a recessed round shape that is complementary to the round shape of the rod end of said actuator, provided in said rotary shaft so that the rod end of said actuator may be moved to abut on said abutting portion and, when said rod of said actuator elongates to thereby cause the rod end to abut on said abutting portion of said rotary shaft,

12 said plurality of arms become rotatable together with said  
13 rotary shaft and, if said rotary shaft stops suddenly, said  
14 rod is retracted, based on a signal from said sensor, to  
15 thereby disengage the rod end from said abutting portion.

1 25. A rotation stabilizing device as claimed in  
2 Claim 21, wherein said safety device comprises a hole  
3 provided in each of said plurality of arms so as to open  
4 at an end face thereof, a spring provided at a bottom of  
5 said hole, a claw member having its one end activated by  
6 said spring and the other end projecting outside said hole  
7 and an abutting portion, having a recessed shape that is  
8 complementary to a shape of the projecting end of said claw  
9 member, provided in said rotary shaft so that the  
10 projecting end of said claw member activated by said spring  
11 may abut on said abutting portion of said rotary shaft and  
12 thereby said plurality of arms are rotatable together with  
13 said rotary shaft and, if said rotary shaft stops suddenly,  
14 said plurality of arms together with said claw member  
15 continue to rotate by inertia force so as to make said claw  
16 member disengageable from said abutting portion of said  
17 rotary shaft and thereby said plurality of arms are made  
18 rotatable freely from said rotary shaft.